Notice of Allowability	Application No.	Applicant(s)	
	10/806,649	ZUNIGA ET AL.	
	Examiner	Art Unit	
	George Nguyen	3723	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to _____.

2. ☒ The allowed claim(s) is/are *1-8*.

3. ☒ The drawings filed on *22 March 2004* are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 032204
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

George Nguyen
Primary Examiner

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

In the specification, page 1, line 3, after "09/903,226" inserted "U.S. Patent No. 6,722,965".

2. The following is an examiner's statement of reasons for allowance: the specific limitations of "a flexible membrane ... joined to a central section of the outer membrane portion" in the combination as claimed in claim 1, and "providing a carrier structure ... and the carrier structure" in the combination as claimed in claim 6 are not anticipated nor made obvious by the prior art of record in the examiner's opinion. For example, with reference to Figures 2-3, Zuniga'6,422,927 discloses a substrate backing assembly 112 includes a flexible internal membrane 116, a flexible external membrane 118, an internal support structure 120, an external support structure 230, an internal spacer ring 122, and external spacer rings 232. The annular volume between base assembly 104 and internal membrane 116 that is sealed by inner flap 204 and outer flap 206 defines a pressurizable floating upper chamber 236. The pressure in floating upper chamber will control a contact area of internal membrane 116 against a top surface of external membrane 118.

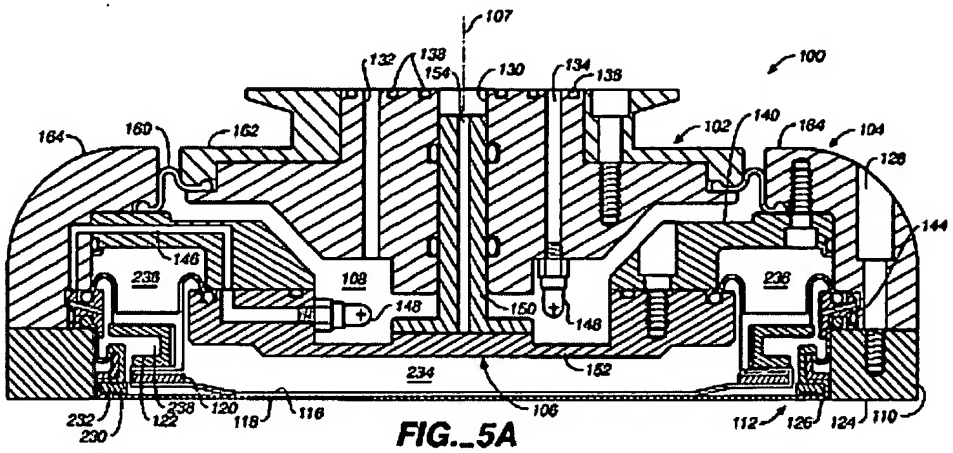
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FIG._5A

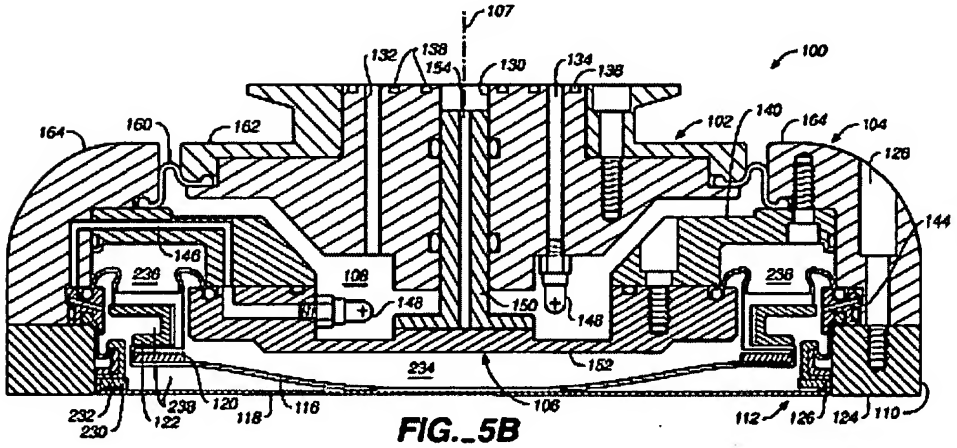
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FIG._5B

about carousel axis 64. Three of the carrier head systems position substrates over the polishing stations, and one of the carrier head systems receives a substrate from and delivers the substrate to the transfer station. The carousel motor may orbit the carrier head systems, and the substrates attached thereto, about the carousel axis between the polishing stations and the transfer station.

Each carrier head system 70 includes a polishing or carrier head 100. Each carrier head 100 independently rotates about its own axis, and independently laterally oscillates in a radial slot 72 formed in carousel support plate 66. A carrier drive shaft 74 extends through slot 72 to connect a carrier head rotation motor 76 (shown by the removal of one-quarter of a carousel cover 68) to carrier head 100. There is one carrier drive shaft and motor for each head. Each motor and drive shaft may be supported on a slider (not shown) which can be linearly driven along the slot by a radial drive motor to laterally oscillate the carrier head.

During actual polishing, three of the carrier heads are positioned at and above the three polishing stations. Each carrier head 100 lowers a substrate into contact with polishing pad 32. The carrier head holds the substrate in position against the polishing pad and distributes a force across the back surface of the substrate. The carrier head also transfers torque from the drive shaft to the substrate.

Referring to FIG. 2, carrier head 100 includes a housing 102, a base assembly 104, a gimbal mechanism 106 (which may be considered part of the base assembly), a loading chamber 108, a retaining ring 110, and a substrate backing assembly 112 which includes three pressurizable chambers, such as a floating upper chamber 236, a floating lower chamber 234, and an outer chamber 238. A description of a similar carrier head may be found in U.S. application Ser. No. 08/861,260 by Zuniga, et al., filed May 21, 1997, entitled A CARRIER HEAD WITH A FLEXIBLE MEMBRANE FOR A CHEMICAL MECHANICAL POLISHING SYSTEM, and assigned to the assignee of the present invention, the entire disclosure of which is incorporated herein by reference.

The housing 102 can be connected to drive shaft 74 to rotate therewith during polishing about an axis of rotation 107 which is substantially perpendicular to the surface of the polishing pad during polishing. Housing 102 may be generally circular in shape to correspond to the circular configuration of the substrate to be polished. A vertical bore 130 may be formed through the housing, and three additional passages (only two passages 132, 134 are illustrated in FIG. 2) may extend through the housing for pneumatic control of the carrier head. O-rings 138 may be used to form fluid-tight seals between the passages through the housing and passages through the drive shaft.

The base assembly 104 is a vertically movable assembly located beneath housing 102. The base assembly 104 includes a generally rigid annular body 140, an outer clamp ring 164, gimbal mechanism 106, and a lower clamp ring 144. A passage 146 may extend through the body of the gimbal mechanism, the annular body, and the clamp ring, and two fixtures 148 may provide attachment points to connect a flexible tube between housing 102 and base assembly 104 to fluidly couple passage 134 to one of the chambers in substrate backing assembly 112, e.g., chamber 238. A second passage (not shown) may extend through annular body 140, and two fixtures (also not shown) may provide attachment points to connect a flexible tube between housing 102 and base assembly 104 to fluidly couple the unillustrated passage in the housing to a second chamber in

The gimbal mechanism 106 permits the base assembly to pivot with respect to housing 102 so that the retaining ring may remain substantially parallel with the surface of the polishing pad. Gimbal mechanism 106 includes a gimbal rod 150 which fits into vertical bore 130 and a flexure ring 152 which is secured to annular body 140. Gimbal rod 150 may slide vertically along bore 130 to provide vertical motion of base assembly 104, but it prevents any lateral motion of base assembly 104 with respect to housing 102 and reduces momement generated by the lateral force of the substrate against the retaining ring. Gimbal rod 150 may include a passage 154 that extends the length of the gimbal rod to fluidly couple bore 130 to a third chamber in substrate backing assembly 112, e.g., chamber 234.

The loading chamber 108 is located between housing 102 and base assembly 104 to apply a load, i.e., a downward pressure or weight, to base assembly 104. The vertical position of base assembly 104 relative to polishing pad 32 is also controlled by loading chamber 108. An inner edge of a generally ring-shaped rolling diaphragm 160 may be clamped to housing 102 by an inner clamp ring 162. An outer edge of rolling diaphragm 160 may be clamped to base assembly 104 by outer clamp ring 164. Thus, rolling diaphragm 160 seals the space between housing 102 and base assembly 104 to define loading chamber 108. A first pump (not shown) may be fluidly connected to loading chamber 108 by passage 132 to control the pressure in the loading chamber and the vertical position of base assembly 104.

The retaining ring 110 may be a generally annular ring secured at the outer edge of base assembly 104, e.g., by bolts 128. When fluid is pumped into loading chamber 108 and base assembly 104 is pushed downwardly, retaining ring 110 is also pushed downwardly to apply a load to polishing pad 32. A bottom surface 124 of retaining ring 110 may be substantially flat, or it may have a plurality of channels to facilitate transport of slurry from outside the retaining ring to the substrate. An inner surface 126 of retaining ring 110 engages the substrate to prevent it from escaping from beneath the carrier head.

Referring to FIGS. 2 and 3, substrate backing assembly 112 includes a flexible internal membrane 116, a flexible external membrane 118, an internal support structure 120, an external support structure 230, an internal spacer ring 122, and an external spacer ring 232. Support structures 120 and 230 and spacer rings 122 and 232 may be "free-floating", i.e., not secured to the rest of the carrier head, and may be held in place by the internal and external flexible membranes.

The flexible internal membrane 116 includes a central portion 200 which will apply pressure to the substrate in a controllable area, a relatively thick annular portion 202 with an "L-shaped" cross-section, an annular inner flap 204 that extends from the corner of L-shaped portion 202, an annular outer flap 206 that extends from the outer rim of L-shaped portion 202, and a perimeter portion 208 that extends around internal support structure 120 to connect L-shaped portion 202 and central portion 200. The rim of inner flap 204 is clamped between flexure ring 152 and annular body 140, whereas the rim of outer flap 206 is clamped between outer clamp ring 164 and lower clamp ring 144. The volume between base assembly 104 and internal membrane 116 that is sealed by inner flap 204 provides a pressurizable floating lower chamber 234. The annular volume between base assembly 104 and internal membrane 116 that is sealed by inner flap 204 and outer flap 206 defines a pressurizable floating upper chamber 236. A second pump (not shown)

e.g., a gas, such as air, into or out of the floating upper chamber **236**. A third pump (not shown) may be connected to bore **130** to direct a fluid, e.g., a gas, such as air, into or out of floating lower chamber **234**. The second pump controls the pressure in the upper chamber and the vertical position of the lower chamber, and the third pump controls the pressure in the lower chamber. As explained in greater detail below, the pressure in floating upper chamber **236** will control a contact area of internal membrane **116** against a top surface of external membrane **118**. Thus, the second pump controls the area of the substrate against which pressure is applied, i.e., the loading area, whereas the third pump controls the downward force on the substrate in the loading area.

The external membrane **118** includes a central portion **210** that extends below external support structure **230** to provide a mounting surface to engage the substrate, and a perimeter portion **212** that extends in a serpentine path between external support structure **230** and external spacer ring **232** to be secured to the base assembly. For example, an edge of the external membrane may be clamped between lower clamp ring **144** and retaining ring **110**. The sealed volume between internal membrane **116** and external membrane **118** defines a pressurizable outer chamber **238**. Thus, outer chamber **238** can actually extend below the lower chamber **234**. A fourth pump (not shown) may be connected to passage **134** to direct fluid, e.g., a gas, such as air, into or out of outer chamber **238**. The fourth pump controls the pressure in outer chamber **238**.

The internal support structure **120** may be a generally rigid annular washer-shaped body located inside floating lower chamber **234** to maintain the desired shape of internal membrane **116**. Alternatively, the internal support structure may be a disk-shaped body with a plurality of apertures therethrough. The disk-shaped support structure would provide a backing surface to prevent the substrate from being damaged due to warping.

The internal spacer ring **122** is a generally rigid annular body which may have a "C-shaped" cross-section. The internal spacer ring may include a cylindrical portion **190**, an annular upper flange **192**, and an annular lower flange **194**. The internal spacer ring **122** may be located in outer chamber **238** above internal support structure **120**. The annular lower flange **194** can be supported by the internal support structure, whereas annular upper flange **192** can extend over external support structure **230** and external spacer ring **232**.

The internal membrane **116** is formed of a flexible and elastic material, such as an elastomer, an elastomer coated fabric, or a thermal plastic elastomer (TPE), e.g., HYTREL™ available from DuPont of Newark, Del., or a combination of these materials. Preferably, internal membrane **116** is somewhat less flexible than external membrane **118**. As discussed above, a controllable region of central portion **200** of internal membrane **116** can contact and apply a downward load to an upper surface of external membrane **118**. The load is transferred through the external membrane to the substrate in the loading area. The bottom surface of central portion **200** of internal membrane **116** may be textured, e.g., with small grooves, to ensure that fluid can flow between the internal and external membranes when they are in contact. The perimeter portion **208** of the internal membrane extends upwardly around an outer surface **180** of internal support structure **120**, and inwardly between lower flange **194** of internal spacer ring **122** and an upper surface **182** of the internal support structure to connect to the lower edge of L-shaped portion **202**. The L-shaped portion **202** of the internal membrane extends inside cylindrical portion **190** and over annular upper flange **192** of the internal spacer ring **122**.

The external support structure **230** is located inside outer chamber **238** between internal membrane **116** and external membrane **118** to maintain the desired shape of external membrane **118** and to seal the external membrane against the substrate during vacuum-chucking. Specifically, external support structure **230** may have a generally rigid ring-shaped portion **170** with an annular projection **172** that extends downwardly from the rim of the ring-shaped portion. Alternatively, projection **172** may be positioned to contact a top surface of the external membrane to preferentially apply pressure to selected areas of the substrate, as discussed in U.S. application Ser. No. 08/907,810, by Steven M. Zuniga, et al., filed Aug. 8, 1997, entitled A CARRIER HEAD WITH LOCAL PRESSURE CONTROL FOR A CHEMICAL MECHANICAL POLISHING APPARATUS, and assigned to the assignee of the present invention, the entire disclosure of which is incorporated herein by reference. The projection **172** may be formed by adhesively attaching a layer of compressible material to a lower surface of ring-shaped portion **170**.

The external spacer ring **232** is a generally annular member positioned between retaining ring **110** and external membrane **118**. Specifically, external spacer ring **232** may be located above external support structure **230**. External spacer ring **232** includes a cylindrical portion **184** and a flange portion **186** which extends outwardly toward inner surface **126** of retaining ring **110** to maintain the lateral position of the external spacer ring.

External membrane **118** is a generally circular sheet formed of a flexible and elastic material, such as chloroprene or ethylene propylene rubber, or silicone. As noted, central portion **210** of the external membrane defines a mounting surface for the substrate, whereas perimeter portion **212** extends in a serpentine fashion between external support structure **230** and external spacer ring **232** to be clamped between base assembly **104** and retaining ring **110**. Specifically, perimeter portion **212** extends upwardly around an outer surface **174** of external support structure **230**, inwardly between flange portion of external spacer ring **232** and an upper surface **176** of external support structure **230**, upwardly around cylindrical portion **184** of external spacer ring **232**, and then outwardly to a rim portion **214** which is clamped between lower clamp ring **144** and retaining ring **110** to form a fluid-tight seal. A "free span" portion **216** of the external membrane extends between rim portion **214** and the outer diameter of the upper surface of external spacer ring **232**. The external membrane **118** may also include a thick portion **218** that extends upwardly between internal spacer ring **122** and external spacer ring **232**. The external membrane may be pre-molded into a serpentine shape.

In operation, fluid is pumped into or out of floating lower chamber **234** to control the downward pressure of internal membrane **116** against external membrane **118** and thus against the substrate, and fluid is pumped into or out of floating upper chamber **236** to control the contact area of internal membrane **116** against external membrane **118**. The ability of carrier head **100** to control both the loading area and the pressure applied to the substrate will be explained with reference to the schematic diagrams of FIGS. **4A** and **4B**. Referring to FIG. **4A**, a hypothetical and highly schematic polisher **300** includes a "free-floating" flexible membrane **302** that defines a pressurizable chamber **306**. Assuming that no external pressures are applied to flexible membrane **302**, it will be generally spherical and have an

However, the prior art of record fails to provide or suggest the specific limitations of "a flexible membrane ... joined to a central section of the outer membrane portion" in the combination as claimed in claim 1, and "providing a carrier structure ... and the carrier structure" in the combination as claimed in claim 6.

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to George Nguyen whose telephone number is 571-272-4491. The examiner can normally be reached on Monday-Friday/630AM-300PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph Hail can be reached on 571-272-4485. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

George Nguyen
Primary Examiner

GN – February 26, 2005

George Nguyen
Primary Examiner
Art Unit 3723